Thermal Diffusivity and Electric Conductivity of Solid Solutions of Silicon and Germanium in Cobalt and Nickel

L.D. Zagrebin, S.M. Perevozchikov, and S.V. Buzilov
Izhevsk State Technical University
Udmurt Republic
Izhevsk, ul. Studencheskaya 7. Russia

The paper considers thermal diffusivity curves *a(T)* of solid solutions of Si and Ge in Co and Ni. Measurements of the thermal diffusivity were performed with the aid of the pulse technique [1] in the temperature range of 300 K to 1600 K. Thermal diffusivity polytherms of Co and Ni alloys feature λ anomaly in the vicinity of the Curie point. Nature of the polytherms varies essentially with the increase of Si and Ge concentration. We note that quantitative influence of germanium additives on the properties of Co, Ni is stronger than that of silicon. In general, polytherms *a(T)* of solid solutions of Ge in Co and Ni are similar in shape. This is explained by a greater average magnetic momentum per atom of cobalt. Concentration curves show abrupt decrease of thermal diffusivity factor as the amount of impurity increases, at high temperatures this changes is less. The paper also studies behavior of the electric conductivity of the alloys under investigation performed using four-probe potentiometer technique. The results have shown that electric conductivity reduces as the amount of impurity (Si, Ge) increases. Computations of thermal diffusivity have allowed to estimate the contribution of different mechanisms of heat transfer. In case of low concentration (up to 4 at. %) heat transfer is provided by the electron component of thermal conductivity. Influence of lattice and magnetic components is low, influence of phonon component is observed only at high temperatures. Numerical separation of the contribution of all the mechanisms is impossible so far due to close relations between the mechanisms.

Complex research of the thermophysical properties of these materials (Ni-Ge, Ni-Si, Co-Ge and Co-Si alloys) allows to make an assumption that Mott's *s-d* scattering mechanism prevails over the scattering of spin-disorders.

[1] S.M. Perevozchikov and L.D. Zagrebin, *Pribory i Tekhnika Eksperimenta* **3**, 155 (1998).